South Sierra Geographic Information Cooperative (SSGIC)

Geo-Spatial Data Clearinghouse

Systems Design Workshop Summary Report

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1.0 Introduction

This document summarizes the South Sierra Geographic Information Cooperative (SSGIC) systems design workshop that took place on August 9-10, 2000 at Mathers Field, CA. This workshop was attended by a number of multi-agency staff as well as consultants from ESRI, Inc. (Redlands, CA) and Pacific Meridian Resources, Inc. (Emeryville, CA). The focus of the workshop was to define Internet based system design alternatives and specifications for a geo-spatial data clearinghouse that will support multi-agency access for wildfire planning and data management.

1.1 Background

The primary objective of the SSGIC project is to create a spatial and attribute information system for coordinated wildfire data management and planning within an integrated Geographic Information System (GIS) framework. This project focuses on utilizing geographic information and related Internet technologies to overcome institutional barriers to interagency fuels and fire related data management within very large, diverse ecosystems. Landscape-scale planning is very difficult within ecologically complex ecosystems that are socially and politically tangled in an irregular pattern of land ownership with diverse management goals.

A seamless systems and data framework is one that provides consistent spatial information across boundaries regardless of agency jurisdictions. This is referred to as a *data clearinghouse*. It is typically beyond the means of any one agency to bridge this information gap and facilitate the development of an ecosystem-wide, wildland fuels-based spatial information management system. Accordingly, the SSGIC project is an interagency initiative that focuses on building a seamless spatial information database (including fuels) and management system to provide agencies with valuable incentives for partnering with other agencies. This initiative includes the gradual institutionalization of an ecosystem-based spatial information management system. Additionally, it includes joint data management protocols, standards, analyses, and spatial data distribution systems.

The development of an integrated Geographic Information System (GIS) framework based on utilizing the latest in Internet deployment approaches will provide updated, spatially-explicit information for planning and implementing fuels management and fire use programs in a consistent and effective manner. This seamless GIS framework will be usable for many other management applications including planning. One of the primary goals is to develop a GIS framework systems model that can be used by local participating agencies and other geographic areas that are multi-jurisdictional and grappling with the same geo-spatial issues and concerns as the southern and central Sierra Nevada land managers.

This document represents the results and recommendations of an initial systems design workshop for the project. It is hoped that the systems deployment alternatives described in this document can be used to guide other geographic areas, and agencies, in the establishment of their own multi-jurisdictional GIS framework.

1.2 Workshop Description

A systems design workshop was held on August 9-10th, 2000 in the Mather Field, CA office of Region 5 of the U.S.F.S. This workshop included participants from multiple agencies as well as consultants from the GIS industry.[1]

[1] Appendix A provides a list of workshop attendees.

The primary objectives of the workshop were to:

1. Provide SSGIC with sufficient information to implement a scalable Internet based GIS data clearinghouse for the duration of the SSGIC project.

2. Provide fire organizations with a range of systems design alternatives for implementing an Internet based GIS data clearinghouse.

3. Define explicit specifications for the systems deployment alternatives.

In ~~To~~ an effort to leverage the developments of private industry and enhance the definition of the systems design alternatives, consultants from ESRI, Inc. (Redlands, CA) and Pacific Meridian Resources, Inc. (Emeryville, CA) were used to facilitate the workshop.[2] The consultants had the following responsibilities:

- ESRI
  - Provide technical information on deploying Internet mapping and data management services using ESRI product offerings.
  - Provide specific hardware and software recommendations for ESRI and related vendor products that meet budget requirements of SSGIC.

- Pacific Meridian Resources
  - Facilitate workshop.
  - Compile workshop findings and final summary report.
  - Provide technical input on PMR experiences/issues with Internet GIS mapping services deployments.

1.3 SSGIC Conceptual Design

The SSGIC project was funded by the Joint Fire Sciences Program to develop a GIS based landscape scale framework for interagency wildland data and fuels management planning. The primary goals of the SSGIC systems are:

1. The most important spatial data for the prototype area is developed, accessible, and available via Internet technologies, referred to as a data clearinghouse.

2. Data utilization tools, such as ESRI's ArcIMS, are implemented to enhance and optimize use and modification of data and related digital output including mapping, data query, and data visualization.

3. Agencies are effectively collaborating making best use of existing and emerging information technologies that serves the key fire information needs of all participating agencies.

4. Standard business processes are developed that optimize long-term interagency information collaboration and cooperation, particularly relating to geo-spatial data.

5. Data utilization tools meet different user requirements and skill levels.

[2] Dave Peters, Head of Systems Integration, ESRI and David Buckley, Corporate GIS Solutions Manager, PMR were the consultants.

The SSGIC data clearinghouse system will provide the following capabilities to satisfy these goals:

1. provide FTP site capabilities to support download of spatial data
2. use of dynamic web pages integrated into a cohesive integrated design, with individual agencies having targeted responsibilities for maintenance and update of selected pages
3. provide an Internet based map server site using ESRI's Arc Internet Map Server (ArcIMS) software to provide access to both map and analysis data created by SSGIC
4. provide an Internet based application server to support data access, project management and collaboration software.

The SSGIC will be responsible for the development and management of the above mentioned services. The SSGIC interagency group will manage the data clearinghouse. This would be a distributed system in which the provider site, i.e. SSGIC, stores the primary geo-spatial data based on watershed delineations and periodically sends or *replicates* selected data sets to a central site main server managed by a hosting agency (to be defined). The Central Site Main Server could be managed by a federal or state agency and would serve large contiguous geographic areas with the data clearinghouse and related Internet mapping services. Other conventional Application Service Provider (ASP) options would be required to host the central site main server.

2.0 Technical Infrastructure

This section summarizes the findings of the workshop with regards to systems design alternatives. It includes:

- description of ESRI Internet product offerings,
- summary of criteria for SSGIC Internet systems design,
- list of SSGIC general user needs and information requirements, and a
- description of viable SSGIC systems deployment alternatives.

2.1 ESRI Internet Product Offerings

This section describes ESRI's Internet product offerings and their characteristics. The ArcIMS software product is the key software for deploying Internet based mapping.

- Web GIS 'services', i.e. web map products, are a *transaction* based environment
  - Providing transaction based 'map services' is a different paradigm than desktop applications, such as ArcView and ArcInfo.
  - Makes use of 'pre-defined products' (maps, reports) from servers. Accordingly, this is more suited for data access, less suited for analysis, or real time, dynamic requirements. ArcIMS is a transaction based environment tool, unlike ArcView or ArcInfo.
  - Supports scalable map services, from local LAN/WAN Intranets ..to.. Internet wide distribution.
  - Supports the separation of different map servers for specific processing loads. This also allows for efficiencies for licensing as well as processing.
  - Distinction between the *map server* and the *web server*. ArcIMS provides the map server functionality.
  - For small sites, the Web server and Map server are typically on the same CPU.

- Alternative remote client access (not Internet) is best to support non-transaction requirements, such as ArcInfo processing
  - 'Terminal servers' – i.e. CITRIX, is possible for many options, such as data maintenance, analysis, since it is not transaction based and does not impact IMS usage. ArcIMS cannot support *persistent* operations and will not be enhanced to support these requirements with future versions.
  - ArcInfo, ArcView is typically utilized with terminal servers. Bandwidth is not typically an issue.
  - In many cases the analysis requirements are typically a small percentage of the access requirements. Accordingly, it makes sense that products like ArcIMS, will not address these requirements.
  - The criteria is 'persistent' operations, like editing, or analysis, i.e. viewshed delineations, GRID models, etc.
  - Currently, ESRI is licensing 8.1 products for Terminal Servers

- Network Configuration
  - Bandwidth is not the issue
  - CITRIX allows real time ArcInfo access (at least close to) as does Web Products such as ArcIMS access.

- Typically 64kb is required for each CITRIX user – need to plan for this based on bandwidth though.
- An potential issue is tuning the data within the client application to only send 'image' of appropriate resolution that needs to occur. A potential issue for network configuration is user access through multi-agency firewalls. Virtual Private Networks (VPN) may provide a viable approach to address these issues. VPNs provide a way to support secure communications over the Internet. This may provide an option for different organizations to establish secure WAN communications using the Internet. For example, the ESRI Systems Group is looking into ways to use VPN technology to connect their Regional Offices to their head office in Redlands. This would allow them to use the Internet technology to replace the current lease lines connecting remote offices with their central office (more bandwidth for less cost). This may be a way to support secure communications between mulit-agencies using Internet communications.

- ArcIMS web services architecture
  - images services vs feature services (feature streaming)
  - other 'private services' are also provided, i.e. geocoding, etc.
  - A concern with ArcIMS is the support for MrSID format imagery. In addition, what is the level of integration and support for imagery with ArcSDE. ArcSDE 8.1 will support a hierarchical resampling of imagery, i.e. referred to as image pyramids, somewhat like MrSID does. This may help ArcIMS and needs to be investigated.
  - AV-IMS and MO-IMS services can be run by ArcIMS for the interim releases of ArcIMS, but will not be supported over the long term.
  - ColdFusion and ASP support for web applications development.[3]
  - Java client provides the 'local' interaction query, view type of capabilities, as well as ability to overlay local data with 'served' data. This is not supported with the HTML client options.
  - Java also supports the ArcExplorer interface tools.

- ArcIMS Map Server Performance
  - When ArcSDE is involved the Map Server off loads many of the query transactions off to ArcSDE software. This enhances the query performance, especially for large data sets.
  - The key to scalability and expansion is by adding to the Map Server level of the configuration. This is the system sizing issue and is the key process.
  - The 'map server' time is key to the entire process – typically it is in the 1-2 sec at this stage.
  - The use of ArcSDE greatly enhances the performance of the Map Server. The typical estimate is double the capacity, but this is conservative.
  - Duplicating *map services* is an option based on tuning the site based on monitoring, especially if a particular 'service' is hit a lot, i.e. most of the time. This may represent a particular 'map' that users hit most of the time.
  - Tuning the number of 'map services' and number of CPU's is critical for performance.
  - The type of CPU for the Map Server is directly proportional to the transaction performance.

Figure 1 provides a conceptual overview of ArcIMS configuration components, including a definition of key issues that affect map server performance.[4]

[3] Appendix C provides an overview comparison of ColdFusion and Active Server Pages as web application server development environments.
[4] This figure has been provided by Dave Peters, ESRI from his white paper on Systems Design Strategies.

Configuration Components

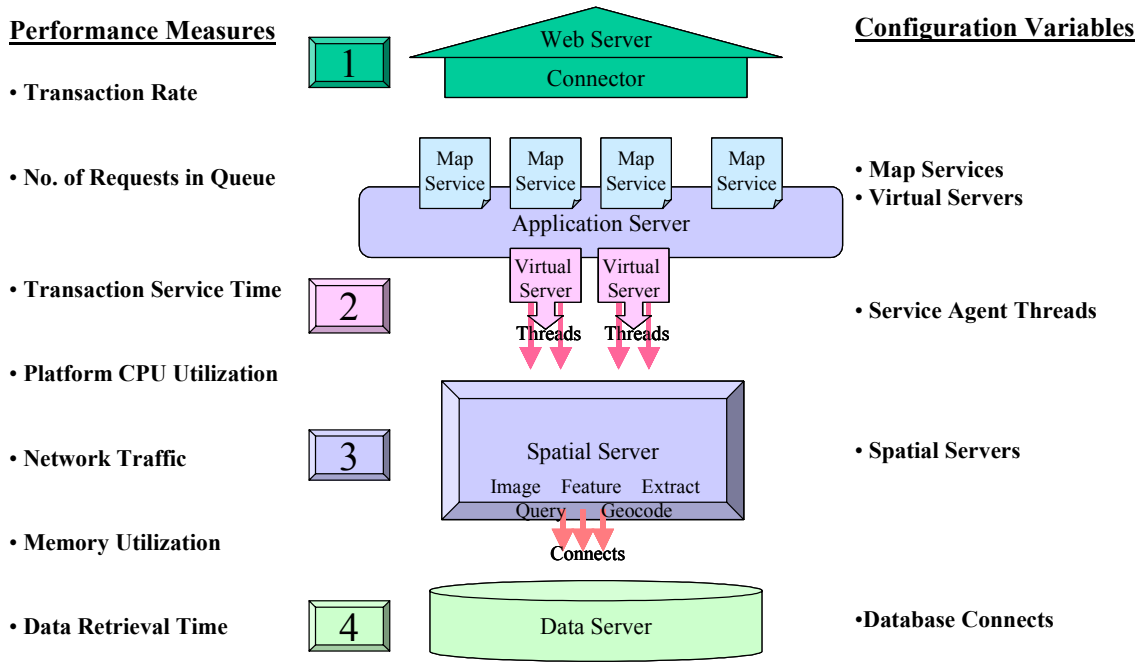

Figure 1: ArcIMS Configuration Components and Variables

To support ArcIMS and related Terminal Server applications the following support information is available from ESRI.

1. An ESRI Demo Portal is available on the Internet for testing ArcIMS and Terminal Server sites. It can be found at:

   http://eslims.ESRI.com

   Username: <select from scroll list>
   Password: esri_wts

2. An ESRI White Paper on Systems Design Strategies (June 2000) is available at:

   http://www.esri.com/library/whitepapers/pdfs/sysdesig.pdf
   This paper provides a detailed review of ArcIMS and ArcSDE systems design issues and requirements. It includes numerous charts and sizing requirements for deployment of these software offerings.

3. Appendix B provides a summary ArcIMS system sizing chart. This document represents a summary of findings from ESRI related to ArcIMS implementations to date.[5]

2.2 General Needs and Requirements

In an effort to provide some scope to the functional requirements of the SSGIC system, a definition of users, information products, software requirements, and priorities was undertaken. Table 1 defines the results of this analysis. The following notes refer to Table 1.

- both Program Staff and Field Staff will require all the capabilities defined for Management Staff, in addition to other capabilities.
- ArcIMS can be used to support the highest priority map and reporting requirements, i.e. Management Staff requirements.
- Download/Upload requirements will have the greatest impact on performance, and hence require the greatest bandwidth.
- Editing and Analysis/Modeling capabilities for GIS staff can be supported through Terminal Server access, or direct on-line access depending on where the SSGIC host server is housed.

Table 1: SSGIC User Requirements Categorization

User Base - WHO?	Information Products - WHAT	Software Requirements-HOW	Priorities
1. Management ▫ Fire ▫ Non-Fire	Standard Maps (95% of products) Standard Reports (95% of reports) Standard Queries (75% of queries) Custom Queries (25% of queries) Redlining/Comments	ArcIMS Active Server Pages, VB ArcIMS, ASP[6], VB, SQL [7] ArcIMS, ASP,SQL, VB ArcIMS-JAVA Client	High High High Medium High
2. Program Staff Examples: ▫ Fuels Specialist ▫ Ecologist ▫ Wildlife Biologist	*Capabilities of (1) above* Download/Upload - products/data Standard Analysis/Modeling - DEMO-3	*See (1) above* FTP+Bandwidth ArcIMS + Custom Map Services (ArcObjects)	 Highest Medium
3. GIS Staff ▫ Coordinator ▫ Analyst ▫ Technician	Special Queries Custom Maps/Reports (5%) Editing Download/Upload – products/data	Windows Terminal Server ArcInfo/ArcView/Other Apps ArcInfo/ArcView/other apps FTP+Bandwidth	Low Low Low Highest

2.3 Key Systems Criteria

[5] Both the Systems Design Strategies white paper, and Appendix B have been provided by Dave Peters, ESRI, Inc. (dpeters@esri.com)

[6] ASP refers to Microsoft Active Server Pages

[7] SQL is required to support queries on the database (DBMS) housing the spatial information and meta-data. The actual web queries are processed through SQL statements in whatever database is used 'underneath', e.g. Oracle, SQL Server 7, Access, etc. This is standard fare and should not require extra licensing. VB scripts are also regularly used within ASP for applications development.

A number of key criteria and user requirements were defined with respect to SSGIC objectives. They are summarized in this section.

2.3.1 Hardware

The following hardware requirements were defined:

- Windows NT Server or 2000 Server
- On-line data storage of at least 50 gigabytes
- Raid Level 5 with tape backup
- Support for up to 1,000 map products transactions per day with less than 5 second response time
- Configuration must be scalable, to support single agency deployment to multiple agency deployment
  - Two primary issues exist with respect to scalability
    - Service time – primarily application and database design issues
      - sophistication of applications – complexity of the transaction
      - size and complexity of data
      - 1 sec service time – standard map products (90% of customers)
      - 2 sec service time – more complex map products – routing, geocoding, more advanced query, etc.
      - 10's of sec – analysis transaction products – custom service - (less than 10%) – typically requires additional CPU's
    - Transaction rate – number of CPU's for Map Server[8]
      - 1 CPU – 1200 transactions per hour (TPH)
      - 2 CPU – 2400 tph
      - 4 CPU – 7000 tph
  - Administration of remote CPU's may be an issue
    - Intel (Windows 2000 Server) for Map Server
    - UNIX is an option for Data Server, but not the web or map server
  - Definition of tiers of CPU platforms to support the different scales of operations[9]
    - 1-2,000 transactions per hour – 1 CPU machine
    - 3,000-5,000 transactions per hour – 2 CPU machine

2.3.2 Software

The following software requirements were defined:

- Internet Information Server (IIS) v5 (component of Windows 2000 Server OS)
- A Java servlet engine, i.e. such as Servlet Exec, Jrun, (allows the web server to run Java servlets)[10]
- ArcIMS (for map server)
- ArcInfo or ArcView to support future editing and analysis (future development options)
- CITRIX for Terminal Server[11] (future development options)

[8] The Map Server is synonymous with ArcIMS usage and must be deployed on Microsoft operating system.
[9] The specific 'population' that the SSGIC site needs to support for ArcIMS is ~~not known at this time~~. anticipated to be less than 1000 transactions per hour for the first two years.
[10] This is not a component of IIS. Numerous options exist. ArcIMS documentation suggests download sites.
[11] Microsoft Windows Terminal Server for Windows 2000 is also an alternative to Citrix Terminal Server.

- Oracle DBMS for database (optional)
- ArcSDE for spatial database enabling (optional)
- Web application software, i.e. ColdFusion, Active Server Pages, JavaScript

2.3.3 Network and Bandwidth

The following network and bandwidth requirements were defined:

- Hosting agency's firewall policy shall not restrict approved local, state or federal agencies from accessing and using the SSGIC site server
- SSGIC server must be available on a 24x7 basis.

2.3.4 Application Service Provider (ASP) Hosting

The following hosting requirements were defined:

- The hosting timeframe for the project is 2 years. Extensions may be negotiated at the end of the period dependant on available funding.
- Support for host Oracle and ArcSDE database administration services is desired.

2.4 Systems Deployment Alternatives

The culmination of the workshop was the definition of systems configuration and deployment alternatives that would address the different levels of user requirements. These were defined as four options:

1. Simple Data Clearinghouse (DataMart)[12]
2. Data Clearinghouse enhanced with map products
3. Spatial Datawarehouse with Map Products
4. Spatial Datawarehouse with Map Products and On-Line Analysis

With each option there is an increased level of complexity in software and hardware requirements. Figures 2 to 5 present the schematic design of each alternative. The alternatives have been configured to support a scalable growth from option 1, the simple FTP based data clearing house, to option 4, the full featured spatial Datawarehouse with analysis capabilities. A description of each alternative is provided.

A critical issue for any alternative is the requirement for remote site administration. For options 1 and 2, remote administration can be completed through both the Internet and/or dial-up connectivity. Most required remote administration tasks would be accomplished through the ASP web application, i.e. file download, upload, etc. System administration tasks, such as backup, file cleanup, etc. would be accomplished using pcAnyWhere. For option 2, administration of map services would also be required, i.e. addition/removal of map layers from map services, since currently ArcIMS remote administration tools have not been certified on Windows 2000.[13]

Remote administrations is particularly important for Options 3 and 4 where more software products, i.e. ArcSDE, Oracle, ArcInfo, are involved and the level of complexity of the system administration tasks

[12] The term DataMart is used by ESRI for the simple data clearinghouse.
[13] This is documented in the current release of ArcIMS (26-Sep-00). ESRI may be able to provide better clarification on this issue with respect to technical product development plans.

increases. Based on our understanding of requirements we recommend the use of Symantic's pcAnyWhere software.[14] Initial testing with Pacific Meridian staff indicate that pcAnyWhere supports remote administration of ArcSDE, Oracle and ArcIMS sites assuming that adequate connection speeds are available.

2.4.1 Simple Data Clearinghouse

- FTP based file server with disk array
- GUI web application built with Active Server Pages (ASP) to support point-and-click web download/upload capability
- Web application to accommodate basic metadata requirements for data upload
- Upload capability to support primary ESRI data formats, i.e. shape files, images, coverages,, in .zip format
- Basic query tools to support query of available data layers and metadata prior to download [15]
- MS-Access to support user administration and meta-data management for web application [16]
- Basic username/password security

2.4.2 Data Clearinghouse with Map Products

- Same FTP capabilities as option 1
- Additional Map Server (ArcIMS) hardware that will also host web server and web application
- Web application will be enhanced to provide ArcIMS mapping capabilities
- A viewing tool (software) will be required to ensure that data uploaded to the server is operational. ArcExplorer would be ideal for this due to no licensing cost.

2.4.3 Spatial Datawarehouse with Map Products

- Same basic configuration as Option 2 enhanced with the ArcSDE/Oracle software bundle to support data serving and extraction services
- All data will be loaded into, and housed, in ArcSDE (Oracle) on the Data Server (file server) [17]
-
- ArcSDE will support feature level data extraction and download

2.4.4 Spatial Datawarehouse with Map Products and On-Line Analysis

- Same configuration as Option 3 supplemented with additional Windows Terminal Server (WTS) hardware

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[14] PcAnyWhere is remote administration software that supports a wide range of connection methods-including standard modems, ISDN lines, TCP/IP and IPX/SPX networks, direct cable, and infrared connections. More information can be obtained from http://www.symantec.com/pcanywhere/index.html.

[15] The 'basic query tools' are the primary functions that allow users to search for available data layers/sets, typically by name, meta-data, scale, geographic area, etc. The basic query functions within a web GUI will help users in searching for data before downloading.

[16] Since this option does not include a DBMS we recommend the use of MS-Access to address database storage requirements. This includes metadata as well as user administration. In Option 3-4 MS-Access would be replaced with Oracle or SQL Server 7.

[17] With Option 3 the File Server becomes the Data Server. It is the same machine with enhanced hardware specifications. We do not need to have a separate File and Data Server. In essence, the File Server is replaced with the Data Server once it becomes ArcSDE enabled.

- The WTS will required ArcInfo or ArcView software license to support analytical, editing processing
- The web application will be enhanced to provide an ArcIMS mapping interface for analytical operations to support posting of map results from WTS operations. This affords the deployment of modeling and analytics to web applications.

2.4.5 Hardware Specifications

The following hardware specifications have been confirmed with ESRI Systems Integration (Redlands, CA) staff for the deployment options:[18]

Option 1: Simple Data Clearinghouse

- File Server System Specifications:
  - Web Server Software
  - Intel hardware - Windows 2000
  - 2 CPU - 866+ mhz
  - 1 gb (min 512) RAM - (more the better for future ArcSDE)
  - 5+ 18 gb drives - 10 slots - High Performance Disk Array RAID 5

Option 2: Data Clearinghouse with Map Products

- Map and Web Server Specifications (single web server and map server):
  - Web Server Software
  - ArcIMS Software
  - Intel hardware - Windows 2000
  - 1 CPU - 866+ mhz
  - 1 gb (min 512) RAM
  - 1-18 gb

- File Server System Specifications:
  - Intel hardware - Windows 2000
  - 2 CPU - 866+ mhz
  - 1 gb (min 512) RAM
  - 5+ 18 gb drives - 10 slots - High Performance Disk Array RAID 5

Option 3: Spatial Datawarehouse with Map Products

- Map Server System Specifications:
  - Web Server Software
  - ArcIMS Software
  - Intel hardware - Windows 2000
  - 2 CPU - 866+ mhz
  - 512 MB RAM

[18] Dave Peters of ESRI confirmed the explicit specifications for the deployment options with ESRI ArcIMS and systems integration staff.

- ArcSDE Data Server System Specifications:
  - ArcSDE
  - Oracle DBMS
  - Intel hardware - Windows 2000
  - 2 CPU - 866+ mhz
  - 1 GB RAM
  - 5+ 18 gb drives - 10 slots - High Performance Disk Array RAID 5

Option 4: Spatial Datawarehouse with Map Products with On-Line Analysis

- Option 3 hardware (see above)
- Windows Terminal Server System Specifications:
  - Intel hardware - Windows 2000 Enterprise Edition (terminal server option)
  - Citrix MetaFrame Software
  - ArcInfo 8 (6 Editor licenses)
  - 2 CPU - 866+ mhz
  - 1.5 GB RAM
  - High Performance Graphics Card (32 MB VRAM)

2.5 Systems Implementation Activities

The following activities were defined to support on-going implementation of the SSGIC systems. Estimates for timelines for completion of key tasks are provided.

Table 2: System Implementation Activities

Description of Task	Timeline
Identify host location and confirm logistics	1-60 days – by Oct 1, 2000
Confirming configuration for initial deployment	1-60 days – by Oct 1, 2000
Purchase/order equipment (30-45 days delivery)	1-60 days – by Oct 1, 2000
System installation – hardware	30-75 days – by Oct 31, 2000
Data model design – entity-relationship definition[19]	75-120 days – by Jan 1, 2000
Software installation, configuration and implementation support[20]	75-120 days – by Jan 1, 2000
Web application development - ASP	90-150 days – by Feb 1, 2001
Web application/interface installation (1-2 day install)	120-150 days – by Feb 1, 2001
Data upload, installation and configuration – populating the data model	120-210 days – by May 1, 2001

[19] Visio 2000 Enterprise (Microsoft Visio) is the preferred database design tool due to its tight integration with Oracle.
[20] Option 3 would require ArcSDE and Oracle requirements. ArcIMS is a one day install. ArcSDE and ArcIMS training required. Oracle DBA knowledge required.

Figure 2: Option 1 - Simple Data Clearinghouse (DataMart)

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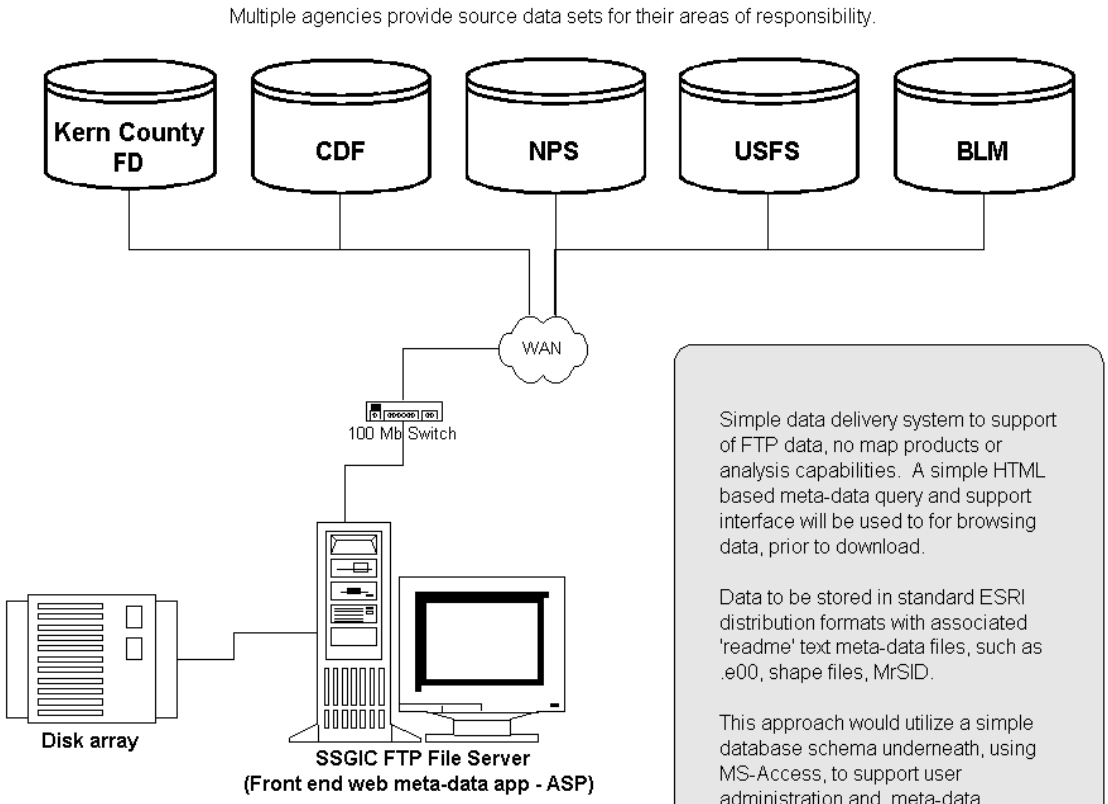
Option 1: Simple Data Clearinghouse (DataMart)



File Server System Specifications:

Intel hardware - Windows 2000
2 CPU (perhaps 4) - 866+ mhz
1 gb (min 512) RAM - (more the better for ArcSDE)
5+ 18 gb drives - 10 slots - High Performance Disk Array RAID 5

Last Updated: 10-Aug-2000

Figure 3: Option 2 - Data Clearinghouse Enhanced with Map Products

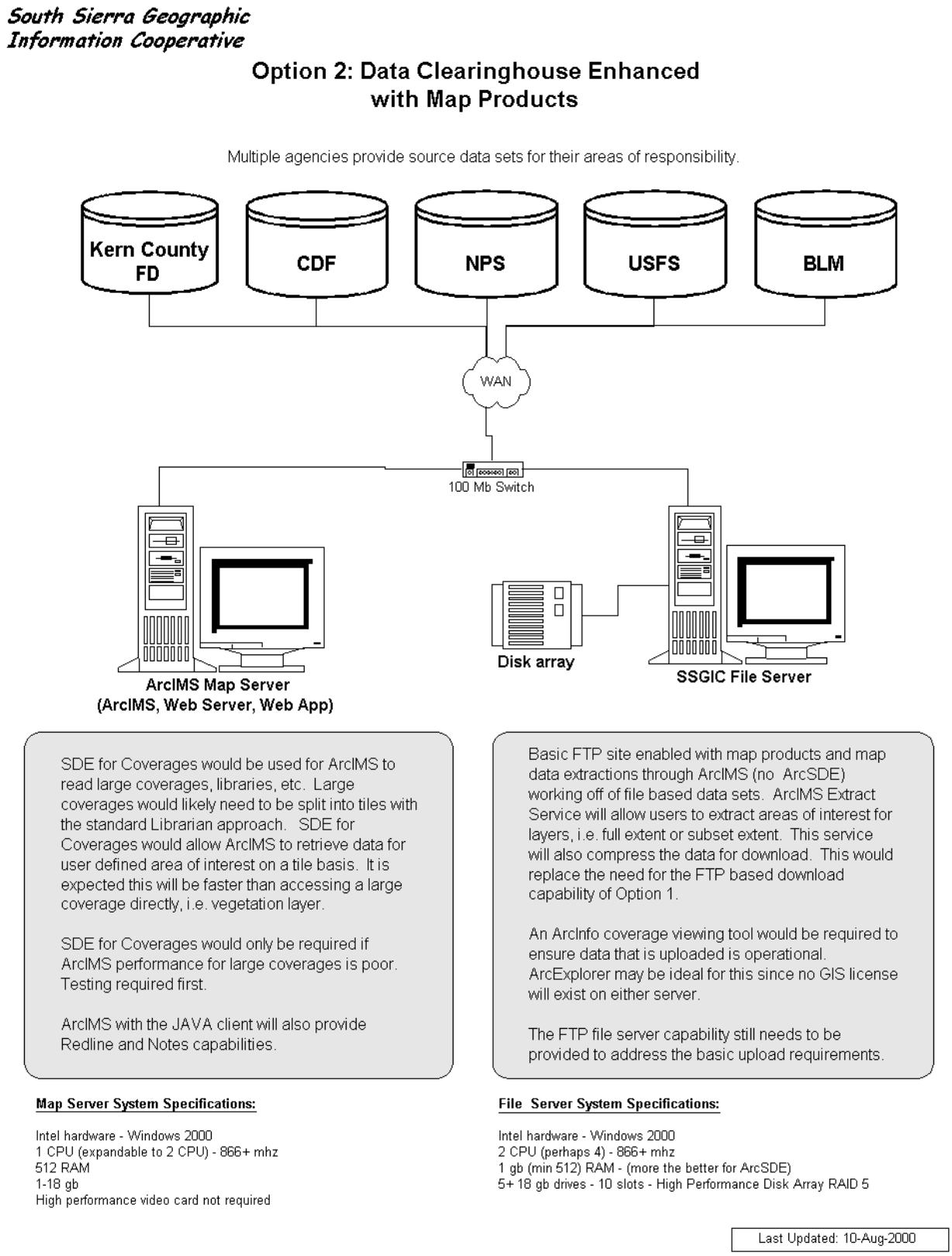


Figure 4: Option 3 - Spatial Datawarehouse with Map Products

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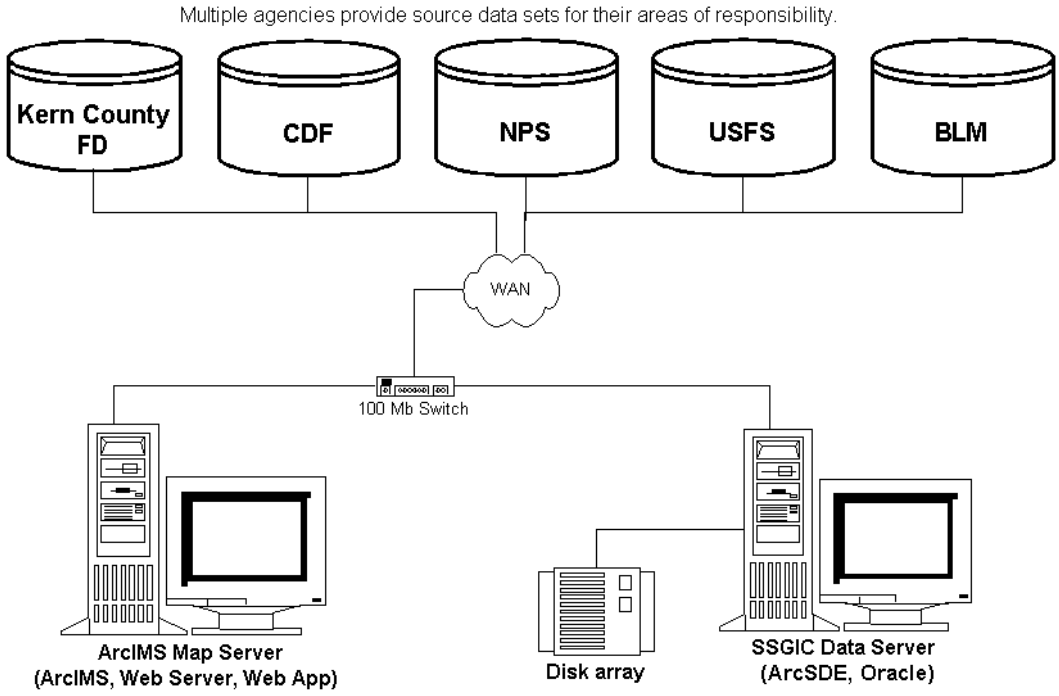
Option 3 :Spatial Datawarehouse with Web Products



ArcIMS Extract Service will allow users to extract areas of interest for layers, i.e. full extent or subset extent. This service will compress the data for download. This would ideally replace the FTP based download capability of Option 1.

The move to ArcSDE would require a DBMS, i.e. Oracle, that will be housed on the Data Server. In essence, this replaces the File Server in previous options. ArcSDE facilitates updating through batch processing, such as extracts and inserts, i.e. moving the data more efficiently. Spatial replication may be an issue for moving data into the ArcSDE-DBMS environment.

Full featured data server enabled with map products and extractions through ArcIMS and ArcSDE. This option extends the SDE for Coverages approach in Option 2 with full featured ArcSDE. ArcSDE facilitates feature level manipulation, such as extraction, rather than tile based extraction with basic SDE for Coverages.

Components will include ArcIMS, ArcSDE and a DBMS (Oracle). Remote administration of ArcSDE and Oracle may be a concern.

The FTP file server still needs to be provided to address the basic upload requirements.

Map Server System Specifications:

Intel hardware - Windows 2000
1 CPU (expandable to 2 CPU) - 866+ mhz
512 RAM
1-18 gb
High performance video card not required

File Server System Specifications:

Intel hardware - Windows 2000
2 CPU (perhaps 4) - 866+ mhz
1 gb (min 512) RAM - (more the better for ArcSDE)
5+ 18 gb drives - 10 slots - High Performance Disk Array RAID 5

Last Updated: 10-Aug-2000

Figure 5: Option 4 - Spatial Datawarehouse with Map Products and On-Line Analysis

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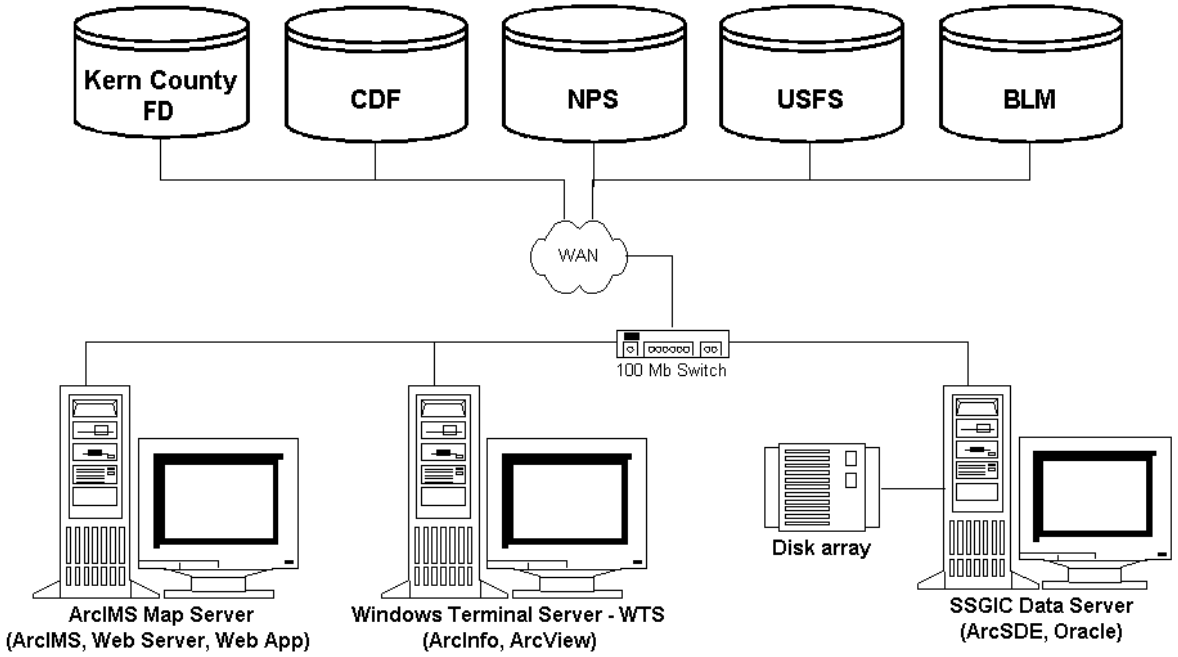
Option 4: Spatial Datawarehouse with Web Products and On-Line Analysis

Multiple agencies provide source data sets for their areas of responsibility.



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Full featured data server enabled with map products and extractions through ArcIMS and ArcSDE, as well as analysis and modeling through ArcInfo. This option extends the ArcSDE approach in Option 3 with full featured ArcInfo through WTS. ArcInfo will facilitate advanced GIS capabilities in addition to transaction based web products. Web interfaces will be required, using ArcIMS, to support WTS ArcInfo access, and display of map output.

Components will include ArcIMS, ArcSDE, Oracle and ArcInfo. ArcInfo would reside on the WTS to support higher end analysis and modeling.

The FTP file server still needs to be provided to address the basic upload requirements.

Windows Terminal Server System Specifications:

Intel hardware - Windows 2000
4 CPU - 866+ mhz
512 RAM
1-18 gb
High performance video card required

Map Server System Specifications:

Intel hardware - Windows 2000
1 CPU (expandable to 2 CPU) - 866+ mhz
512 RAM
1-18 gb
High performance video card notrequired

File Server System Specifications:

Intel hardware - Windows 2000
2 CPU (perhaps 4) - 866+ mhz
1 gb (min 512) RAM - (more the better for ArcSDE)
5+ 18 gb drives - 10 slots - High Performance Disk Array RAID 5

Last Updated: 15-Aug-2000

Appendix A : Workshop Attendees

The following table identifies the attendees of the SSGIC workshop.

Name	Affiliation	Phone	Email
Dorothy Albright	USFS R-5	916-364-2823	dpalbright@fs.fed.us
Craig Dalby	NPS	206-220-4160	craig_dalby@nps.gov
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Karen Holmstrom	SSGIC	559-784-1500	karen_holmstrom@fs.fed.us
Dave Duran	NPS – WASO	303-969-2176	david_duran@nps.gov
Pat Lineback	SEKI	559-565-3725	pat_lineback@nps.gov
Dave Peters	ESRI	909-793-2853	dpeters@esri.com
Gladys Crabtree	NIFC - NPS	208-387-5214	gladys_crabtree@nps.gov
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Appendix B: ArcIMS System Sizing Chart

The information in this appendix has been provided by Dave Peters, Systems Integration, ESRI, Inc. (Redlands, CA). Dave can be reached at dpeters@ESRI.com

The following information can be used as a guide to recommending hardware for ArcIMS Spatial Servers. System capacity is a function of hardware platform performance, map complexity, and data source. Sizing applies only for standard HTML/Image processing (does not address data streaming or downloads). Solutions are configured to support a peak 5-sec service time (includes transaction queue wait time).

Standard Map Products
(2-sec Service Time on PIII 500)

Peak transactions/hour	Hardware Vendor	
	Intel	Sun Solaris
1-1000	PIII Xeon 1-866, 256 MB RAM	Ultra 60 1-450, 256 MB RAM
1001-2000	PIII Xeon 2-866, 512 MB RAM	Ultra 80 2-450, 512 MB RAM
2001-4000		Ultra 80 4-450, 1 GB RAM
4001-5000	PIII Xeon 4-700, 1 GB RAM	
5001-6000		E3500 3-400 1 GB RAM
6001-7000	PIII Xeon 6-700, 1.5 GB RAM	E3500 4-400 1 GB RAM
7001-10,000		E3500 5-400 1.25 GB RAM

Double transaction rates with ArcSDE data source (separate platform)

Light Map Products
(1-sec Service Time on PIII 500)

Peak transactions/hour	Hardware Vendor	
	Intel	Sun Solaris
1-2000	PIII Xeon 1-866, 256 MB RAM	Ultra 60 1-450, 256 MB RAM
2001-4000	PIII Xeon 2-866, 512 MB RAM	Ultra 80 2-450, 512 MB RAM
4001-8000		Ultra 80 4-450, 1 GB RAM
8001-10,000	PIII Xeon 4-700, 1 GB RAM	
10,001-12,000		E3500 3-400 1 GB RAM
12,001-14,000	PIII Xeon 6-700, 1.5 GB RAM	E3500 4-400 1 GB RAM
14,001-20,000		E3500 5-400 1.25 GB RAM

Double transaction rates with ArcSDE data source (separate platform)

Multiple spatial server platforms can be configured as a cluster for capacity expansion and fault tolerant high availability operations. ArcIMS application server (map service queue) should be configured on a separate Web server to support high availability operations.

Appendix C: Review of Active Server Pages and ColdFusion

This appendix provides an overview of the ColdFusion and Active Server Pages web application server software environments.

Active Server Pages

What it is:
Active Server Pages (ASP) is Microsoft's web server scripting environment. Utilizing either VBScript (a subset of the widely used Visual Basic language) or JavaScript (commonly used for client side scripting), a developer can write programs which run on a web server, and dynamically generate web pages which are sent to the client. These programs are referred to as Web Applications. ASP pages are interpreted and compiled on the fly. IIS can be configured to cache the pages to increase performance on pages that don't change very often.

Used By:
ASP is used by a wide range of sites, from very small sites to very large sites such as Dell.com and Barnes & Nobel (bn.com). It scales quite well, and can utilize clustering and fail-over technologies.

Technology:
ASP runs on Microsoft Internet Information Server (IIS) on Windows. For development work, Windows 95,98,NT Workstation or Win2000 Professional can be used. For deployment, a server class OS should be utilized (WinNT/2k server). ASP itself is included with IIS. As ASP is commonly written in VBScript, it is fully COM compliant. Many companies make ASP components which facilitate complex tasks, such as un-zipping up-loaded files.

Development Tools:
ASP files, as with most server side scripting technologies, are simply text files. As such, Notepad can be used to develop ASP applications. However, it is much better to use a development environment such as Microsoft's Visual Interdev (a member of the Visual Studio family). Visual Interdev allows the developer to edit and debug server side and client side scripts, design, build, and edit databases, as well as create and edit database SQL scripts and stored procedures. Additionally, if Visual Basic and/or Visual C++ are also installed, the user can create and edit project components written in those languages. Visual Interdev also integrates with Visual Source Safe – the source control system that comes with Visual Studio. Visual Studio costs about ~$1500 per user.

ColdFusion

What it is:
ColdFusion (CF) is another server side scripting environment. It utilizes a tag based programming language similar to HTML, called CFML. For users familiar with HTML it is quite easy to learn, and is quite powerful. Compared to ASP, a non-visual basic programmer will find ColdFusion easier to get started with. Conversely, more experienced programmers can find ColdFusion's extremely flexible programming style difficult to *componentize* for re-use. There is a recent movement by the ColdFusion community to adopt a programming style known as FuseBox, which promotes re-usability.

Used By:
EtradeBank.com and ESRI use ColdFusion for their sites. ColdFusion tends to be used for small to medium size sites. This is not to say that larger sites cannot use it, but it is somewhat un-structured programming style, and lack-luster COM integration have left it out of the running when compared to other offerings.

Technology:
ColdFusion has it's own server component which interprets the CFML and returns HTML to the web server. As such, it is available on a number of platforms, including Windows, Solaris and Linux. The development environment is only available on windows at this time. The server software costs ~$1500 for the basic level, and ~$3500 for the enterprise version. One downside of ColdFusion is its COM integration: you can use COM objects with ColdFusion, but it is quite difficult.

Development Tools:
ColdFusion, similar to ASP, could be written in Notepad. However, most developers use ColdFusion Studio. This package facilitates the editing of CFML, with GUI interfaces for many of the tags. It does not have a database design/edit capability. ColdFusion Studio costs ~$1200.

Bottom Line:
ASP and ColdFusion are quite similar in many respects. Both have their up-sides and downsides. ASP is a better choice if the Windows platform meets the requirements, and the developers are experienced with Visual Basic. ColdFusion is a better choice if the system must run on another platform, or the development team is composed of less-experienced programmers. A final tip of the scales may come at the price – ASP is free with the OS, and ColdFusion costs ~$1500 (min.) on top of the OS.